

REMARKS

Claims 1-21 are pending in this application. Claims 1-6, 8, and 10-21 are rejected. Claims 7 and 9 are objected.

Claims 7 and 16 have been amended to remove a comma and to replace a comma with a period, respectively. No new matter has been introduced by these amendments. Reconsideration and withdrawal of the pending rejections are respectfully requested in view of the amendments and remarks submitted herein.

Response to Rejections under 35 U.S.C. § 102

Claims 1, 2, and 14-21 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,124,619 to Fitton *et al.* According to the Examiner at page 2 of the Office Action:

Fitton discloses...a process in which a solution of 1,4-diacetoxy-2-butene and hydridocarbonyltris-(triphenylphosphine)rhodium (I) in benzene was to 75° C in a 1 liter stainless steel bomb under a pressure of 2000 p.s.i.g. of synthesis gas....After completion, removal of benzene by distillation from the resulting solution gave 1,4-diacetoxy-2-formylbutane in 77% yield with presumed 100% selectivity.

Applicants respectfully traverse this rejection.

Fitton, *et al.* describes a hydroformylation process using the homogeneous Rhodium catalyst system. This process requires a further distillation step to separate the catalyst from the reaction mixture, i.e., a two step separation, and results in an unstable catalyst after distillation at higher temperatures. All of the examples in Fitton utilize a homogeneous catalyst that is in the same phase as the reactants. For example, Examples 1-11 at columns 4-6 demonstrate homogeneous catalysis in a single liquid phase.

In contrast, the instant reaction employs the use of an immobilized, heterogeneous Rhodium catalyst. Applicants respectfully direct the Examiner's attention to the specification, throughout which the applicants discuss the use of such heterogeneous catalysts. The heterogeneous nature of these catalysts allows for separation from the reaction mixture by simple filtration techniques in a single step.

Fitton describes the use of a homogeneous catalyst, and neither discloses nor suggests the claimed invention, which employs the use of a heterogeneous Rhodium catalyst. Because the claimed invention is directed to the use of such heterogeneous catalysts, the present invention is neither anticipated by nor made obvious in view of Fitton. The applicants, therefore, respectfully request reconsideration and withdrawal of the § 102 rejections to claims 1, 2, and 14-21 for the reasons above and claims as presented.

Response to Rejections under 35 U.S.C. § 103

Claims 1-6, 8, and 10-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over US 4,124,619 to Fitton *et al.* in view of El Ali *et al.* (Abstracts of Papers 224th ACS National Meeting, 2002). Specifically, the Examiner states on page 4-5 of the office action that:

One of ordinary skill in the art would have been motivated to modify the process off [sic] Fitton by employing the immobilized catalyst of El Ali by the desire to simplify recovery of the catalyst for reuse in the reaction...There would have been a reasonable expectation for success based upon El Ali's teaching that his catalyst was suitable for use in hydroformylation reactions.

Applicants respectfully traverse the Examiner's contention.

The Examiner states that Fitton "does not contemplate the use of an immobilized catalyst while such is instantly employed." Fitton is therefore combined with El Ali for teaching that "Rhodium triphenyl phosphate catalyst can be immobilized using a heteropolyacid as an

anchor on the surface of MCM-41 as a solid support and used in a hydroformylation reaction” (Office Action- page 4). The Examiner admits that “[a]lthough El Ali is silent with regard to where the catalyst attaches,” the Examiner “presumes, absent evidence to the contrary, that attachment occurs at both inner (entrapment) and out surfaces.” Further, the Examiner admits that El Ali “is also silent with regard to the specific heteropolyacid employed but the Examiner considers El Ali’s generic teaching of a heteropolyacid to encompass phosphotungstic and phosphomolybdic acids which are the most well known of the heteropolyacids and are most commonly found to have a Keggin-type structure.”

Applicants assert that there is no motivation to combine Fitton with El Ali. Fitton teaches hydroformylation of biscarboxylic esters of but-2-ene-1,4-diol. In contrast, El Ali teaches hydroformylation of styrene. The differences between biscarboxylic esters of but-2-ene-1,4-diol, as hydroformylated in Fitton, and styrene, as hydroformylated in El Ali, are so significant that one skilled in the art would not expect an effective catalyst for the hydroformylation of styrene to be an effective catalyst in the hydroformylation of biscarboxylic esters of but-2-ene-1,4-diol. As such, one would not be motivated to combine the references.

Specifically, styrene is a monosubstituted, aromatic alkene, whereas a biscarboxylic ester of but-2-ene-1,4-diol is a disubstituted, aliphatic alkene. As an aromatic alkene, the double bond in styrene is in conjugation with the aromatic ring. In contrast, the double bond in a biscarboxylic ester of but-2-ene-1,4-diol is isolated. Due to these distinctions, the double bonds in these two very different hydroformylation substrates have significantly different steric environments and electronic structures. One of ordinary skill in the art would expect that these differences in sterics and electronics would result in systems with *unique and independent reactivity*. Moreover, styrene is a hydrocarbon, containing only hydrogen and

carbon atoms, whereas a biscarboxylic ester of but-2-ene-1,4-diol contains heteroatoms, specifically, oxygen atoms, capable of interacting with metals such as rhodium. One of ordinary skill in the art would expect the presence of heteroatoms to further alter the reactivity of a biscarboxylic ester of but-2-ene-1,4-diol relative to styrene. Because of these differences in the chemical properties of the hydroformylation substrates in the two cited references, combined with the statement in El Ali that rhodium (III) complexes have “very low catalytic activity in the hydroformylation reaction,” one skilled in the art would not expect the catalyst described in El Ali to catalyze the formation of γ -hydroxy tiglic aldehydes taught in Fitton. Thus, the skilled artisan would not be motivated to modify the teachings of Fitton with the conditions described in El Ali to catalyze the hydroformylation of biscarboxylic esters but-2-ene-1,4-diol to result in the claimed invention.

For the above reasons, the applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. § 103(a) rejections to claims 1-6, 8, and 10-21.

Response to Claim Objections

Claim 7 has been amended to delete the extraneous comma between the words “phosphino” and “methane” to address the Examiner’s concerns. Reconsideration and withdrawal of the objection are respectfully requested.

Applicants acknowledge that Claims 7 and 9 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. However, based on the foregoing arguments and amendments, applicants submit that the base claims are in a condition for allowance, and reconsideration and withdrawal of the objection are respectfully requested.

CONCLUSION

Based on the foregoing amendments and remarks, Applicants respectfully request reconsideration and withdrawal of the rejection of claims and allowance of this application.

AUTHORIZATION

The Commissioner is hereby authorized to charge any additional fees which may be required for consideration of this Amendment to Deposit Account No. **13-4500**, Order No. 3097-4015.

In the event that an extension of time is required, or which may be required in addition to that requested in a petition for an extension of time, the Commissioner is requested to grant a petition for that extension of time which is required to make this response timely and is hereby authorized to charge any fee for such an extension of time or credit any overpayment for an extension of time to Deposit Account No. **13-4500**, Order No. 3097-4015.

Respectfully submitted,
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